measurements of fifty pairs of twins from nine to fifteen years old in six mental traits, and their bearing upon the comparative importance of heredity and environment as causes of human differences in intellectual achievement.

FIVE new volumes—Nos. 146 to 150 inclusive—of Ostwald's "Klassiker der exakten Wissenschaften" have been received from the publisher—Mr. W. Engelmann, Leipzig. No. 146 is a paper by Lagrange (1768), translated from the French and edited by Herr E. Netto, the title being "Über die Lösung der unbestimmten Probleme zweiten Grades." J. B. Listing's "Beitrag zur physiologischen Optik," edited by Prof. O. Schwarz, forms No. 147 of the series; and a lecture delivered at Vienna by E. Hering in 1870, "Über das Gedächtnis als eine allgemeine Funktion der organisierten Materie," constitutes No. 148. Under the title "Tastsinn und Gemeingefühl," an article contributed by Dr. E. H. Weber in 1846 to R. Wagner's "Handwörterbuch der Physiologie" is reprinted with notes by Herr E. Hering. Of particular interest is the reprint (No. 150), edited by Herr A. von Oettingen, of Fraunhofer's paper entitled "Bestimmung des Brechungs- und Farbenzerstreuungs-Vermögens verschiedener Glasarten, in bezug auf die Vervollkommnung achromatischer Fernröhre." This volume contains a plate showing Fraunhofer lines in the solar spectrum, and a picture of the statue of Fraunhofer at Munich.

OUR ASTRONOMICAL COLUMN.

COMET 1905c (GIACOBINI).—Observing at Sunderland on December 22, 1905, Mr. Backhouse estimated that the magnitude of comet 1905c was approximately 8·3, at 18h. 40m. G.M.T., the observation being made in faint twilight; its diameter he found to be $5\frac{1}{2}'$.

As this comet now rises but about an hour before sunrise, and the apparent distance from the sun is decreasing, it will be scarcely possible for further observations to be made before February, when the comet should again become visible, possibly to the naked eye, in the evening sky.

EPHEMERIS FOR HOLMES'S COMET (1892 III., 1899 II.).—The following search-ephemeris for Holmes's comet is published by Herr H. J. Zwiers in No. 4063 of the *Astronomische Nachrichten*:—

1906	α (app.) *oh. G.M.T.*	δ (app.)
	h. m. s.	° ′ ″
January 11	21 5 39	−18 59 53
,, 13	21 9 45	−18 30 19
,, 15	21 13 51	−18 0 25
,, 17	21 17 57	−17 30 13
,, 21	21 26 7	−16 28 55
,, 25	21 34 15	−15 26 26
,, 29	21 42 21	−14 22 49

In referring to the ephemeris for comet 1892 V. in these columns last week, that object was designated, by mistake, Holmes's comet. Both bodies were discovered at about the same time, and their periods are very similar, but comet 1892 V. is the faint one discovered by Prof. Barnard, by photography, on October 12, 1892, and was not seen on its return in 1899. A report that it has been detected at the La Plata Observatory is as yet not confirmed.

On the other hand, Holmes's comet was bright enough in 1892 to be observed with the naked eye, and, owing to its eccentric fluctuations in brightness, was described by Prof. Barnard as certainly the most remarkable comet he had ever seen, taking everything into consideration. During an interval of fourteen minutes its diameter, as observed with the 36-inch refractor, increased from 43″·4 to 47″·9, and the comet became perceptibly brighter whilst under observation. This comet was first seen on its return in 1899 by Prof. Perrine on June 10 of that year. According to the above ephemeris, the comet should set about ninety minutes after sunset on January 11, but probably its low declination will make it a difficult object to find.

PHOTOGRAPHS OF THE SOLAR GRANULATIONS.—Using the astrographic telescope of the Pulkowa Observatory, Prof. Hansky has obtained some exceedingly interesting photographs of the solar granulations and spots on a large scale. The solar image at the focus of the instrument has a diameter of 3 cm., and by the use of an achromatic double concave lens was enlarged up to 54 cm. (about 21 inches).

The negatives thus obtained were photographically intensified by repeated copying, and details of the granulations became visible. Portions of the strengthened images were then enlarged to such a scale that the solar diameter would be equal to 6 metres (*i.e.* nearly 20 feet).

Copies of the sections thus enlarged are reproduced in the bulletin issued by Prof. Hansky, and on comparing two which were taken with an interval of twenty-five seconds it is seen that the granulations have undergone but little change, although relative movement and changes in brightness are discernible. Photographs taken with an interval of one minute show great changes, and after three minutes only one or two of the granules are recognisable.

The dimensions of the granules vary considerably; the smallest measured had a diameter of about 670 km., the largest about 2000 km.

Prof. Hansky intends to prosecute this research further, and hopes thereby to solve several questions regarding the periodic appearance of granules, the effects of their movements on spots and faculæ, &c.

THE ORBIT OF ξ URSÆ MAJORIS.—On many grounds the determination of the correct orbit of the double star ξ Ursæ Majoris is of great interest and importance, and for this reason M. N. E. Nörlund, of Copenhagen, has made a very careful re-investigation of the available data and measurements. About eighteen orbits have been computed previously.

The results of this investigation are given in No. 4064 of the *Astronomische Nachrichten*, and the places computed from the elements obtained are compared with those obtained by many different observers.

For the period M. Nörlund obtains 59·8096 ± 0·06 years, for the time of periastron 1815·957, for the distance $a = 2''\cdot5128$, and for the eccentricity of the orbit $e = 0\cdot4108$.

THE INTERNATIONAL FISHERY INVESTIGATIONS.[1]

THE first of the reports referred to below is the first report of the British North Sea Investigations Committee on the International Fisheries Investigations. From time to time during the last three years in which the investigations have been in progress, the International Council has issued the "Bulletin des Resultats," in which are contained the results of the hydrographical and plankton investigations carried out on the periodic cruises; and also the series of "Publications de Circonstance," containing the results of incidental investigations carried out by the various naturalists on the staffs of the different committees. Quite recently, too, the council has issued the third volume of "Rapports et Procès-Verbaux," containing a *résumé* of the results obtained up to the present time. The present volume is, however, the first report which deals exclusively with the results obtained by the British vessels. It is a report to the Fishery Board for Scotland on part of the investigations made by the Scottish staff.

The first three papers in the report, written by Messrs. Helland-Hansen and Robertson, deal with the hydrography of the Færöe-Shetland channel and the adjacent sea regions—the area investigated by the Scottish vessels, H.M.S. *Jackal* and the *Goldseeker*. The principal Scottish line of hydrographical stations extends from the Shetlands to the Færöe Islands, and it is along this line that the changes taking place in the constitution of the sea-water can most easily be observed. It has long been known that the water in this region may be derived from various

[1] "Report on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters, 1902–3." Edited by D'Arcy W. Thompson. Pp. vii+618. [Cd. 2612.] (London: H.M. Stationery Office, 1905.) Price 8*s.* 9*d.* net.

"Report on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters, 1902–3." Report No. 2 (Southern Area). Edited by Dr. E. J. Allen. Pp, ix+377. [Cd. 2670.] (London: H.M. Stationery Office, 1905.) Price 8*s.* 9*d.* net.

sources. We have to deal first of all with the "Gulf Stream," or, as it is now termed, the "Norwegian branch of the European stream," which, originating in the Atlantic Ocean, flows north and east through the Scotland-Shetland and the Færöe-Shetland channels, sometimes reaching as far north as the Murman coast. A second component is water of Arctic origin which enters the Shetland-Færöe channel as an offshoot from the east Icelandic polar stream. Further, the hydrography of these regions is complicated by the occasional presence of water from the Norwegian Sea, from the coasts of Britain, or from the North Sea itself. These various components are traced by observations of their salinity, temperature, and plankton contents. The Norwegian branch of the European stream is shown to exhibit a well marked periodicity. In 1903 the inflow of Atlantic water through the Shetland-Færöe channel decreased from May on, and practically ceased in November, resuming in February of 1904. The southerly polar stream attained its greatest volume in spring; it is apparently able to make its way southwards at all seasons of the year, either as an undercurrent or at the surface. When it is strong it may obstruct the Norwegian stream in the Færöe-Iceland channel, and cause the latter to pass to a greater extent between Scotland and Shetland. These are the principal results attained so far, and they do not add much to our knowledge of the hydrography of these regions; but it must be remembered that they are founded on the results of one year's complete investigations only, and are best to be appreciated at the end of the five years' investigations and when they are considered along with the results attained by the other investigations now in progress.

A most important part of the original scheme of investigations was the discussion of the statistics obtained by the participating States. These matters receive proper attention in the present volume, and Prof. Thompson discusses in a very attractive manner an interesting series of statistics furnished by the Granton Steam Fishing Company, and a similar series of statistics given by the steam trawlers owned by Messrs. Johnston, of Montrose. In each case the average catch per vessel has been calculated, and tables and curves are given showing, in an interesting fashion, the seasonal fluctuations of the fishes under review, which are haddock, whiting, cod, plaice, turbot, and lemon sole. In the case of each fish there are generally two maxima of abundance, one of which is always well marked and the other not so well shown. In the case of the haddock there is, however, a very close correspondence between the catch of this fish and the surface temperature of the sea, a correspondence which Prof. Thompson points out is most probably due to the fact that the great summer fishery for herring takes place at the time when the surface waters of the sea have their greatest temperature, and when the haddock is shoaling to feed on the herring spawn. It is notable that in neither of these cases is there any certain indication of a progressive decrease or increase in the volume of the catches of any of the fishes in question.

Perhaps the most valuable paper in the volume is that contributed by Dr. Fulton in which he elaborates the method of studying the distribution and seasonal fluctuations of fishes first suggested by him in the reports of the Fishery Board for Scotland some years ago. This consists in obtaining accurate records of the catches made by a large number of trawlers, and also information of the places where these catches were made. This plan of obtaining commercial fishery statistics (apart, of course, from the ordinary official figures) was first practised by the Fishery Board, and a considerable number of Aberdeen steam trawlers now regularly provide these figures. The first results of these investigations were published in the annual reports of the Fishery Board, but they are now utilised in connection with the other investigations of the international organisation. The figures are collected by the statistical staff of the Fishery Board at the market in Aberdeen, and are expressed as the quantities of fish caught per vessel per 100 hours' fishing. The North Sea is divided into a number of squares, each of which is bounded by one degree of latitude and two degrees of longitude. All the catches of fish made on each of these squares during each month of the year are then brought together and expressed as the cwts. of fish caught per 100 hours' fishing on each area, and curves are constructed which are superposed, and so show in a very instructive manner the variation in the abundance of each kind of fish from month to month during the year. It is thus shown that there are two maxima of abundance for each fish during the year, one of which corresponds with the spawning time of the species. It is further shown that there is a "complementary or compensating fluctuation" among different species on the same ground, one species becoming abundant as another becomes scarce, so that the sum total of the species on the same ground remains nearly constant during the year.

Other reports in the same volume are those by Dr. T. Scott on the crustacea collected during the seasonal cruises of the *Goldseeker*, and similar papers by Mr. Clark on the other plankton collections. Prof. Thompson also contributes a translation of a paper by Sandstrom and Helland-Hansen on the mathematical investigation of ocean currents. It is regrettable that the fishery experiments of the *Goldseeker* have not been described and summarised in this volume, but these will no doubt be the subject of a future report. One must not omit to mention the beautifully engraved charts of the North Sea which illustrate the paper on the trawling statistics of Aberdeen.

The second of the reports under notice deals with the part of the international investigations which was entrusted to the Marine Biological Association, and gives an account of the researches carried out in the southern part of the North Sea and in the English Channel. In some respects this report is complementary to that issued by the Scottish Fishery Board; in the latter special attention is directed to the results of the hydrographical work and to statistical studies, while fishery investigations are not reported upon. In the English Blue-book, on the other hand, the bulk of the space is devoted to an account of the fishery investigations. The hydrographical researches, which are reported only by Mr. D. Matthews, were carried out in a somewhat limited area, but are of very great interest. It is shown that the water in the English Channel is derived from two main sources:—(1) high salinity water (35·6 parts per thousand and upwards), which enters the Channel as a current flowing in a northerly direction from the Bay of Biscay; and (2) low salinity water, entering the Channel as a southerly current from the Irish Sea and the Bristol Channel. The limits of these contributing currents are well shown on the hydrographical charts, where the lighter water is seen to be present mainly to the west of a line running roughly south from the Scilly Isles; while the denser water forms a tongue of variable magnitude, according to the season, entering the Channel in a north-easterly direction near Ushant. Within the Channel itself the hydrographical conditions are very complex; a general drift of surface water from west to east has been observed, but the distribution of the high and low salinity waters in the Channel is far from simple. Generally speaking, the main source of the water entering the Channel during the summer and early autumn is the Irish Sea, while during the rest of the year the denser water of the Bay predominates. The observations have been made for a year only, so that the very important question whether or not these changes in the origin of the contributing waters are periodic remains still to be investigated.

Perhaps the most interesting part of the report is that by Mr. Garstang dealing with the results of experiments on the marking and liberation of living plaice and other fishes. These experiments have now been carried out by most of the national research staffs, and are yielding results which are very instructive from the point of view of the growth and migrations of the plaice especially. The mark used is a brass label bearing a number, and fastened to the body of the fish by means of a silver wire passing through the body and attached to the other side by a bone button. This mark can be attached to the fish without permanent injury to the latter, and apparently without any retardation of growth or other disturbance of the normal habits of the fish. The results are recorded in Mr. Garstang's report, and are illustrated by means of synoptical charts which show the principal migrations made by the fishes which have been recovered. Up to the end

of 1903, 1463 plaice were marked in this way, and of these 287, or 19 per cent., have been returned to the association. The general facts regarding migrations brought out by these experiments are these:—the smaller fishes do not appear to migrate to any considerable extent, and the larger the fish is the more extensive are its migrations. In some cases the distance travelled has been very considerable; thus one plaice is shown to have travelled a distance of 175 miles in about six weeks, and another travelled a distance of 210 sea-miles in eight months. The general trend of the migrations has been in a southerly direction during the winter and in a northerly one during the summer. As a rule, the smaller fishes travel from the shallow water "nurseries" to the deeper waters during the earlier period of their life.

A most attractive part of these migration experiments is the question of the transplantation, on a commercial scale, of fishes from overcrowded grounds to those grounds where the conditions for favourable growth are present, but where there is not already an abundant population of the kind of fish in question. An interesting account of such an experiment is given by Mr. Garstang. Although the conditions of nutrition on the well known Dogger Bank are apparently very favourable for plaice, yet, on account of its comparatively isolated situation, this area contains a population of plaice which is probably far below that which it is able to support. Accordingly, more than 1000 small plaice were transplanted from certain in-shore grounds to the Dogger Bank, and in the course of a year more than 40 per cent. of these fishes were re-captured from the Bank itself and the slopes around it. It is shown that the growth-rate of these fishes was far in excess of that of those living on the ordinary in-shore fishing grounds, and the question of the practicability of the wholesale transplantation of small plaice from the shallow-water fishing grounds to such grounds as the Dogger Bank is carefully discussed. It is very questionable, however, whether transplantation operations on such a scale could be arranged at all so as to be successful.

The remainder of the report deals with the records of the fishing experiments and with various other matters. Dr. Wallace presents a report on the growth-rate of the plaice based on the examination of the annual growth-rings in the otoliths. Mr. Todd contributes a lengthy account of his examination of the contents of the stomachs of a very great number of fishes caught in the course of the trawling operations, and draws some interesting conclusions on the food of the various species dealt with. Lastly, Mr. Gough reports on the occurrence and distribution of the plankton of the English Channel during 1903.

The records of the trawling experiments contain a large mass of observations which are capable of much further analysis than has been attempted in the present report. 84,000 measurements of individual fishes have been made in the North Sea and in in-shore waters, and when these are considered along with the records of the hauls made by the Scottish Fishery Board's exploring steamer abundant material should be forthcoming for a discussion of the distribution of fishes in the North Sea according to their age and size. Altogether the North Sea Fisheries Investigation Committee is to be congratulated on the publication of these reports. J. JOHNSTONE.

INSECT PESTS OF THE COTTON PLANT.[1]

THESE two reports may be taken as object-lessons of the way in which such economic investigations should be carried out by the agricultural departments of progressive countries.

The wide area over which cotton cultivation is spreading makes the investigation of its enemies in those regions where it has long been cultivated of great value. Such researches guide us in investigating new enemies, and they prepare us to guard against the introduction of pests with foreign seed.

The authors of the report on the bollworm have produced a work of great value to all cotton planters. The pest is recorded from North and South America, the West Indies, Europe, many parts of India, China, and Japan, the East Indies, Australia and New Zealand, and even in the Gilbert and Navigator Islands. Of particular interest is the record from the Sudan and British East Africa, but it is not recorded as attacking cotton there. Besides infesting cotton, it is equally destructive to corn, and the authors tabulate seventy other food plants, distributed over twenty-one natural orders.

There are excellent plates showing ova, larvæ damaging the buds, tassels and ears of sweet-corn as well as cotton.

The injuries are explained, and it is clearly pointed out how the cotton becomes infested by the third and fourth

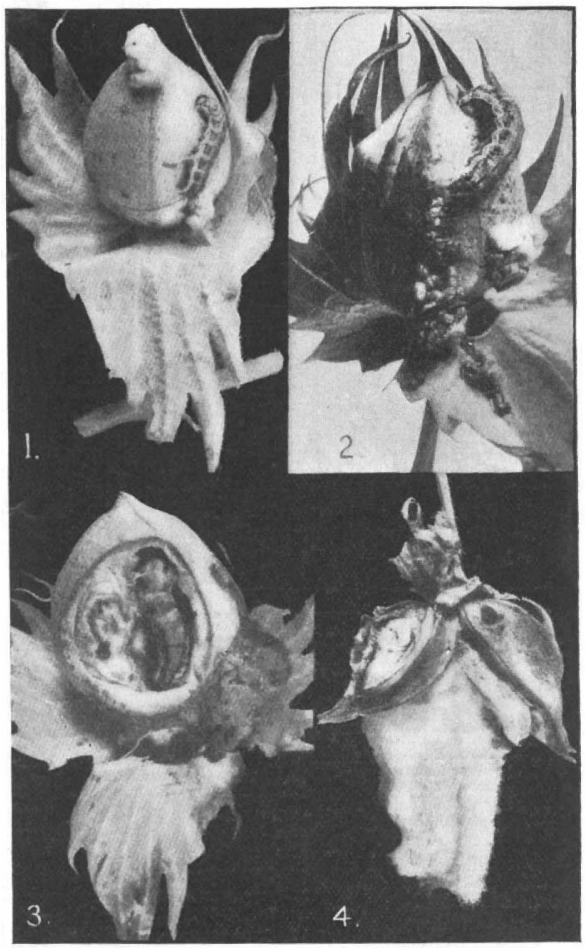

FIG. 1.—Work of Bollworm in Cotton Bolls. 1, Bollworm eating into a half-grown cotton boll; 2, bollworm boring into a full-sized cotton boll; 3, full-grown bollworm and its work in large cotton boll; 4, cotton boll only partially destroyed by bollworm, two "locks" open, the others destroyed (original).

generations of larvæ, the previous ones feeding upon the corn.

The summary given of the life-history shows that the moth may lay from 500 to 3000 eggs, especially upon the "silks" of corn and the "squares" of cotton. During warm weather they hatch in two or three days. In spring the young larvæ eat the buds, later the silks and tassels of the corn; in August and September they attack the cotton. They bore directly into the "squares" and "bolls," and destroy the latter. Maturity is reached in two weeks; they then enter the soil to pupate. Detailed descriptions are given of all the stages, the effects of climate, and variations in colour. Nothing definite is shown to account for the great variation seen in the larvæ.

[1] "The Cotton Bollworm." By A. L. Quaintance and C. T. Brues. U.S. Department of Agriculture, Bureau of Entomology, *Bull.* 50. Pp. 155+plates xxv+figs. 27. (1905.)
"The Mexican Cotton Boll Weevil." By W. D. Hunter and W. E. Hinds. *Idem*, *Bull.* 51. Pp. 181+plates xxiii+figs. 8. (1905.)